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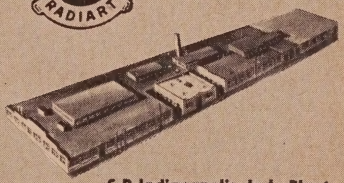

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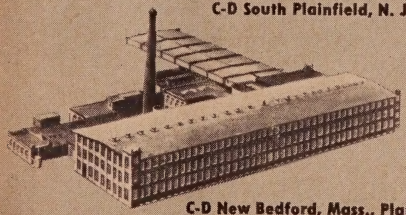

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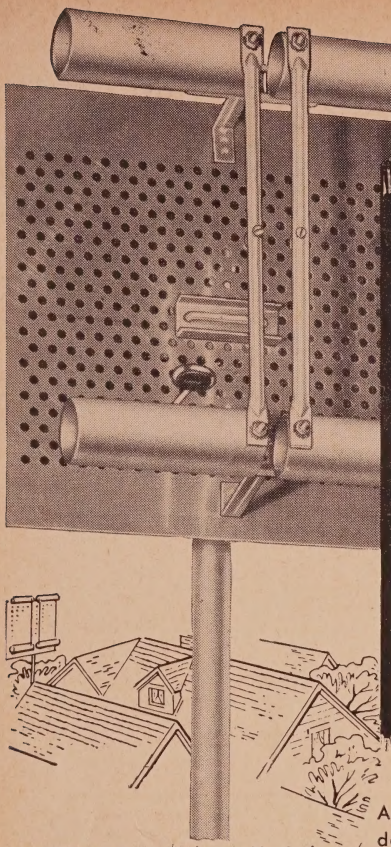

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TECHNIQUE OF WAVE ANALYSIS

A pure sine wave seldom is encountered in actual practice. Even when considerable pains are taken to generate a single-frequency voltage, a small amount of harmonic energy can be detected in the product. Thus, alternating currents or voltages generated either electronically or electromechanically contain several harmonically-related frequency components, in addition to the fundamental, although these extraneous products may through critical design be held to low orders of magnitude. Practical a. c. waves accordingly are complex in nature.

Operation of various pieces of electronic equipment, such as amplifiers, detectors, modulators, demodulators, transformers, and phase inverters, inherently introduce harmonic components on a nearly perfect sine wave being transmitted through their circuits. This distortion is of considerable concern in amplification and in instrumentation. Measurement of its magnitude determines the fidelity of the circuit or system.

Investigation of the harmonic content of the output voltage of a. c. generators (oscillators or machines) is important in developing this equipment and checking its regular operation, since power largely is wasted in harmonics.

Any complex wave may be resolved into a series of component sine waves. Mathematical analysis of a complex wave may be performed from a plot of one cycle of the wave as displayed by an oscilloscope or oscillograph. However, this is an involved process seldom employed outside of special research laboratories and in the classroom.

Practical Wave Analysis

The fundamental and harmonic components of audio-frequency voltages (20 to 20,000 cycles per second) may be measured in the laboratory and field by means of instruments of several types. Each of these **wave analyzers** is designed so as to measure the amplitude of **each** frequency component separately. Figure 1 shows a possible distribution of fundamental and harmonic amplitudes in a complex waveform. Here component amplitude is represented by vertical height, and component frequency by horizontal position.

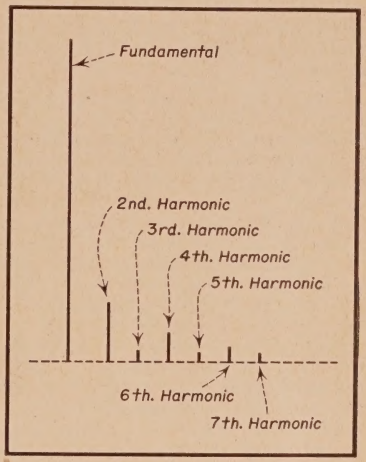


Fig. 1. Relative amplitudes (exaggerated) of fundamental and harmonic frequencies in a complex waveform.

The wave analyzer, unlike the **total distortion meter** which now is so well known to sound technicians, does not indicate the total harmonic content of a complex wave directly. Instead, it shows how much of each component is present. In its conventional form, the wave analyzer is tuned separately and successively to each component, and each of the various amplitudes is read on an indicating meter. The panoramic type of wave analyzer on the other hand, may be regarded as being tuned automatically, since it

scans the audio-frequency spectrum and provides an oscilloscopic display of the fundamental frequency and a number of harmonics simultaneously.

Heterodyne Wave Analyzer

The most sensitive and selective of the manually-tuned instruments is the heterodyne wave analyzer, also called a harmonic wave analyzer. In configuration and circuitry, this instrument resembles a superheterodyne radio receiver, except that the former is operated at audio frequencies instead. It may be regarded also as a highly-selective tuneable vacuum-tube voltmeter.

Figure 2 is a functional block diagram of a heterodyne wave analyzer. Notice the similarity to a superheterodyne receiver. This instrument consists of an input amplifier (A) which provides the high input impedance necessary for bridging audio circuits; a special detector-mixer (B) known as a **balanced modulator;** a tuneable heterodyne (local) oscillator (E) which operates at a radio frequency, or very high audio frequency, and provides a signal which is mixed with the incoming audio frequency, f_1, in the balanced modulator stage; a fixed-tune selective amplifier (C) which is operated at either the beat-note sum or difference between the incoming audio frequency and the heterodyne oscillator frequency; and (D) a vacuum-tube voltmeter-millivoltmeter.

The circuit operates in the following manner. The incoming audio-frequency signal (f_1) is applied to the balanced modulator through the input amplifier. Also supplied to the balanced modulator is the signal from the tuneable oscillator stage. The oscillator tuning is adjusted so that either the sum or difference of the audio and the oscillator equals the high frequency to which the selective amplifier section is sharply adjusted. When the oscillator is so tuned, a signal passes through the selective amplifier (similar to transmission through the i. f. amplifier in a radio or television receiver) and deflects the v. t. voltmeter. This deflection is proportional to the amplitude of the incoming audio component.

In Figure 2, the oscillator frequency is shown equal to the sum of the audio frequency (f_1) and the single frequency of the selective amplifier (f_2). This means that the frequency passed by the selective amplifier will be the beat-note difference between the audio and oscillator frequencies. This difference frequency is the lower sideband of the modulation product. The oscillator frequency also might have been chosen equal to f_2-f_1; whereupon the selective amplifier would op-

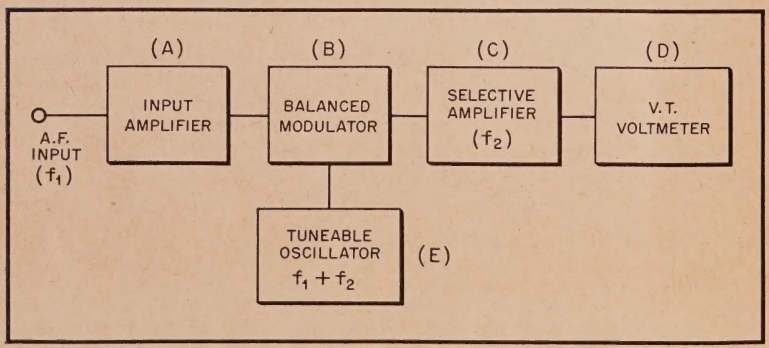


Fig. 2. Block diagram of Heterodyne wave analyzer.

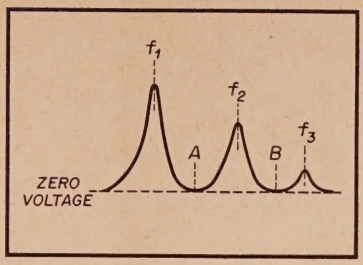


Fig. 3. Wave-amplitude relationships in complex waveform.

erate at the same frequency as previously, but the sum of the audio and oscillator frequencies (the upper sideband of the modulation product) would be passed by the selective amplifier.

As an example, consider an applied audio frequency of 1000 cycles. Consider also that the selective amplifier section is fix-tuned to 50 kc. In order to transmit a signal through the selective amplifier to the v. t. voltmeter, the heterodyne oscillator then would have to be tuned either to 51,000 cycles or to 49,000 cycles. If then we desired to inspect the second harmonic of the 1000-cycle signal, the heterodyne oscillator would have to be tuned either to 48,000 cycles or to 52,000 cycles. Inspection of the 3rd harmonic (3000 cycles) would require tuning the oscillator either to 47,000 cycles or to 53,000 cycles. Thus, the system can be tuned to each harmonic simply by setting the heterodyne oscillator to the proper frequency to produce a beat note equal to the frequency of the selective amplifier. The dial of the heterodyne oscillator therefore can be graduated directly in cycles per second corresponding to the signal at the input of the instrument.

The bandwidth of the selective amplifier must be so narrow that no voltage due to one harmonic can reach the v. t. voltmeter when the system is tuned to the next higher harmonic. In order to appreciate the need for this extreme sharpness, consider the task of checking the low fundamental frequency of 20 cycles and its various harmonics. The selectivity of the system must be high enough that tuning may be accomplished successively to 20 cycles (fundamental), 40 cycles (2nd harmonic), 60 cycles (3rd harmonic), etc., each time with no interference from either of the other frequency components. The required half-band width thus must be 10 cycles. At higher frequencies, the **numerical** selectivity, of course, changes value. For example; when the fundamental frequency is 1000 cycles per second, the harmonics are spaced 1000 cycles apart, and the required half-band width is 500 cycles.

The wave-amplitude relationships and required bandwidth may be visualized more clearly by reference to Figure 3. Points f_1, f_2, f_3 represent deflections of the terminating voltmeter in the wave analyzer for a fundamental frequency, second harmonic, and third harmonic, respectively. These points are spaced apart by an amount equal to the value of the fundamental frequency, f_1. In order that there be no spurious deflection of the meter from the other points when the instrument is tuned to any one of the frequencies, points such as A and B between the tuning peaks must represent zero voltage. Since these latter points are halfway between successive frequencies, the maximum distance from a peak to a zero-voltage point is one-half the frequency separation. This is equal also to one-half the minimum required bandwidth (represented by the distance from A to B). This is why the selectivity is expressed in units of **half-band** width. In the case of 1000 cycles, previously cited; point f_1 represents 1000 cycles, f_2 2000 cycles, and f_3 3000 cycles. The distance from f_1 to f_2 is 1000 cycles, as is also the distance between f_2 and f_3. The space f_1 to A therefore is 500 cycles, as is also A to f_2, f_2 to B, and B to f_3. The maximum allowable bandwidth for operation without interference (e. g., A to B) is 1000 cycles,

and minimum half-band width (e. g., f_1 to A) therefore is 500 cycles.

To the reader schooled in superheterodyne theory, some question will arise as to why a special mixer must be used at position B in Figure 2, instead of the usual 1st detector. The need for a special circuit in this stage may be explained as follows. The tuneable oscillator (E) operates at frequencies close to that of selective amplifier (C). In fact, if the difference-frequency beat note is employed, the oscillator operates exactly at the frequency of the selective amplifier when the instrument is at zero frequency. Some means therefore must be provided for cancelling the oscillator frequency from the output of stage B and passing only the beat-note frequency to the selective amplifier, otherwise the v. t. voltmeter will be deflected spuriously by the oscillator voltage. A conventional 1st detector-mixer would not provide this suppression.

How the balanced modulator circuit accomplishes oscillator carrier cancellation, while transmitting the beat-note product, may be seen by reference to Figure 4. The input audio signal is applied by transformer T_1 to the grids of V_2 and V_3 in pushpull (out of phase). This signal therefore appears in the primary of transformer T_3 but is not passed to the secondary because this unit is a low-frequency r. f. transformer. The oscillator signal, on the other hand, is applied by transformer T_2 to the tube grids in **parallel.** It therefore cannot appear in the primary of T_3 because any given half-cycle of oscillator voltage excites the two grids equally in amplitude and phase and causes the tube plates (and the corresponding ends of the primary winding of T_3) to assume equal voltages of identical polarity. The oscillator signal thus is suppressed in T_3, and the audio signal cannot be passed by this transformer either. The only signal transmitted by T_3 ac-

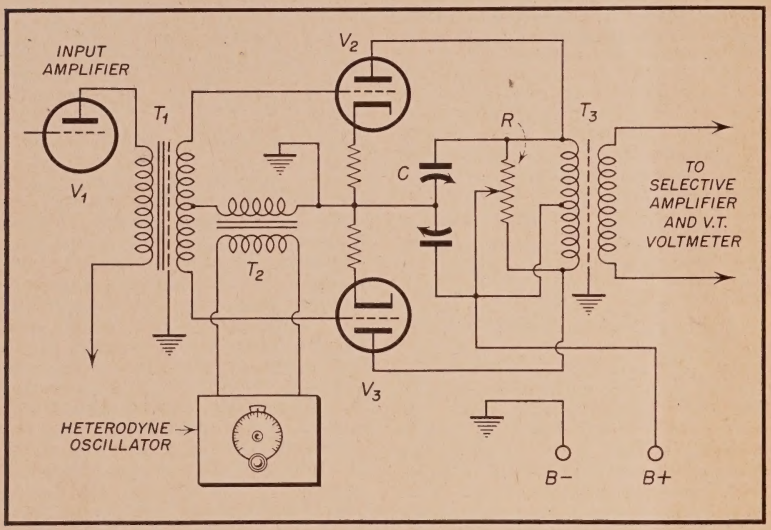


Fig. 4. Simplified circuit of balanced modulator.

cordingly is the beat note between the audio and oscillator signals. The split capacitor (C) and potentiometer (R) are employed to balance the circuit against slight differences between tubes and circuit constants in opposite halves of the circuit. While triodes are shown for simplicity in Figure 4, pentodes often are employed in commercial wave analyzers.

Since the heterodyne process between the audio input signal and heterodyne oscillator carrier produces both sum and difference beat notes, either one of these modulation products conceivably might be selected for use. The selective amplifier channel of the instrument is fix-tuned to accept only one. The selective amplifier may be considered as a band-pass filter having extremely narrow bandwidth. In some wave analyzers, the selectivity of this channel is made adjustable from a front-panel control, in order that the selectivity might be reduced at high frequencies where the extreme sharpness of tuning would lead to difficult manipulation of the tuning dial and also to inaccuracies of reading.

Commercial heterodyne wave analyzers employ some variation of the arrangement illustrated by block diagram in Figure 2. The main differences between instruments are in the type of selective amplifier channel used and the input frequency range. For comparison, the following paragraphs list the important features of several heterodyne wave analyzers which are widely used in the laboratory and field.

General Radio Type 736-A. This instrument has a tuning range of 20 to 16,000 cycles. This range is covered with one rotation of the local oscillator dial.

Two inputs are provided. The direct input has an impedance of 1 megohm and allows direct indication of signal-voltage amplitudes between 10 microvolts and 300 volts on the output meter. The second is a 100,000-ohm input potentiometer used when direct voltage indications are not required.

The selectivity, which is constant over the entire tuning range, is such that response is down 60 db at 30 cycles from a signal peak. Response is down 30 db at 10 cycles off peak.

Figure 5 is a skeleton circuit of the 50-kc. selective i. f. channel employed in the Type 736-A wave analyzer. For simplicity, all power wiring has been omitted. The sharp tuning of this channel is obtained through the use of a crystal-filter amplifier containing three 50-kc. quartz crystals, X_1, X_2, and X_3. The voltage at the secondary of input transformer T contains both the upper and lower side-

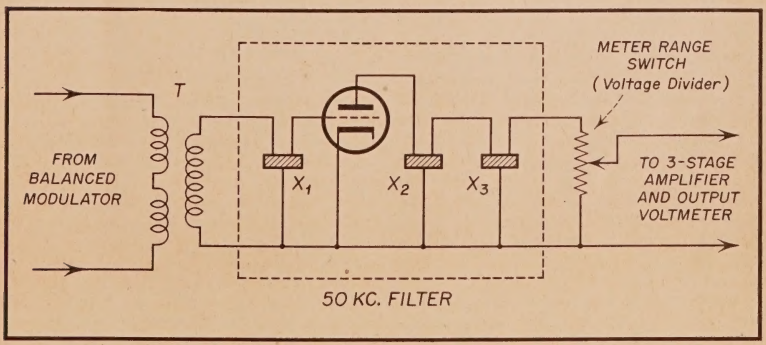


Fig. 5. Selective I. F. channel in General Radio Wave Analyzer.

bands, but no voltage due to the carrier of the local (heterodyne) oscillator. The 50-kc. pass frequency of the i. f. channel represents the upper sideband. The amplitude of this sideband, which also is proportional to the amplitude of the signal component under measurement, is indicated by the output v. t. voltmeter-millivoltmeter. The

Hewlett-Packard Model 300A. This wave analyzer has a tuning range of 30 to 16,000 cycles. This range is covered with one rotation of the local oscillator dial.

Input impedance is constant at 200,000 ohms. This high value permits bridging in circuits under test with negligible loading.

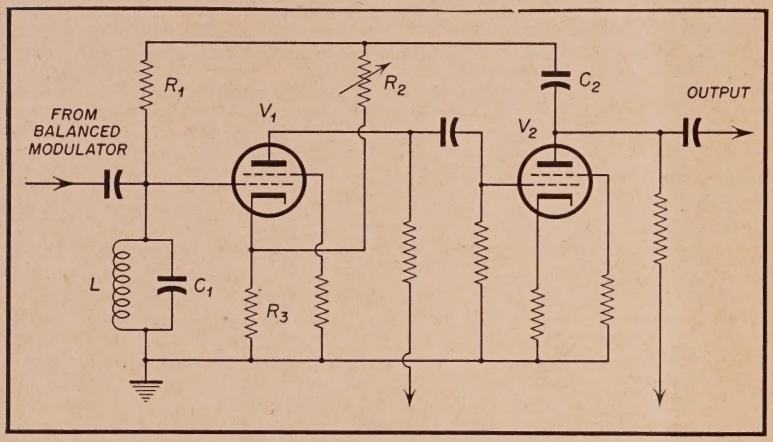


Fig. 6. Selective I. F. stage in Hewlett-Packard Wave Analyzer.

latter is operated, through a 3-stage amplifier, from the i. f. amplifier (50-kc. filter) output.

The input signal (consisting of a fundamental and numerous harmonics) is delivered to the balanced modulator by a phase inverter stage. Elimination of the customary input transformer at this point in the circuit removes the possibility of external-field pickup.

The highest frequency to which this instrument can be tuned is 16,000 cycles. This would be the second harmonic of 8 kc., the third of 5333 cycles, the fourth of 4000 cycles, the fifth of 3200 cycles, etc., etc.

Hum in the instrument is suppressed 75 db. High-order modulation products arising in the balanced modulator are suppressed 70 db.

Four maximum input-voltage ranges are provided: 0.5, 5, 50, and 500 volts. Full-scale ranges of the indicating output meter are 1, 2.5, 5, 10, 25, 50, 100, 250, and 500 millivolts. These ranges are multiplied by settings of a front-panel selector.

The selectivity of the instrument is continuously variable, by means of a front-panel control, from a half-band width of 30 cycles to a half-band width of 145 cycles. This adjustable-selectivity feature permits broadening of the response at high frequencies where unecessarily sharp response would make tuning difficult.

The circuit of the 20-kc. selective i. f. amplifier is unique in the method employed to obtain sharp response. Figure 6 is a skeleton circuit of one

of the stages in this amplifier channel. For simplicity, all power circuitry has been omitted from this diagram. A high-Q 20-kc. tuned circuit is provided by inductor L and capacitor C_1. Two resistance-coupled amplifier stages (V_1 and V_2) are associated with this tuned circuit. Negative feedback is provided through C_2, R_2, and R_3, while positive feedback is supplied through C_2, R_1, L, and C_1. At the resonant frequency of L and C_1, the positive feedback balances the negative feedback. Off resonance, however, negative feedback lowers the output of the circuit. This reduction is added to the normal falling-off of response on each side of resonance due to the selectivity of the L-C_1 combination. This action amounts to an increasing of the Q, and accordingly the selectivity, of the L-C combination. The sharpness of response thus depends upon the amount of negative feedback which is controllable manually by means of potentiometer R_2. Four stages, each similar to the one shown in Figure 6, are operated in cascade in the adjustable-selectivity i. f. amplifier in the Hewlett-Packard instrument. The maximum selectivity of this system is such that response is 60 db down at 53 cycles off resonance.

The variable-frequency local oscillator employs a resistance-capacitance type of circuit. This arrangement provides stable operation and, because it uses no inductive components, is not subject to interference from magnetic fields.

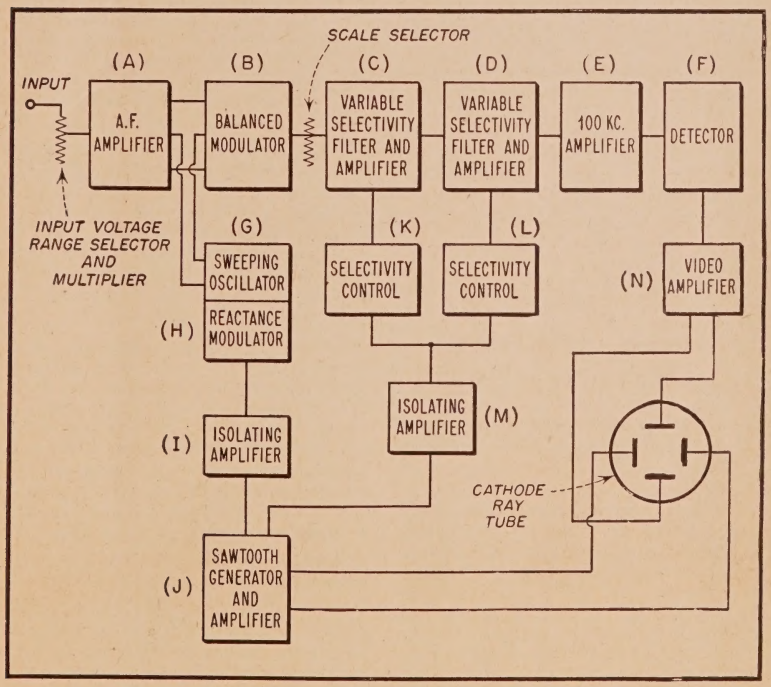


Fig. 7. Block diagram of Panoramic Model AP-1 Sonic Analyzer.

The balanced modulator employs a pair of pentode tubes with resistance and capacitance balancing adjustments operated from the front panel of the instrument. The output frequency is the difference-frequency sideband.

Panoramic Model AP-1. In each of the heterodyne-type wave analyzers described previously, manual tuning and output-meter indication are provided. A second type of wave analyzer makes use of the heterodyne circuit, but acts as an **audio spectrum analyzer,** having entirely automatic recurrent sweeping of the audio spectrum and providing a visual display of all of the frequency components simultaneously on the screen of a cathode ray tube. Such an instrument is the Panoramic Model AP-1, shown in functional block diagram in Figure 7.

A typical display, such as might be viewed on the screen of the sonic analyzer, is shown in Figure 8. The

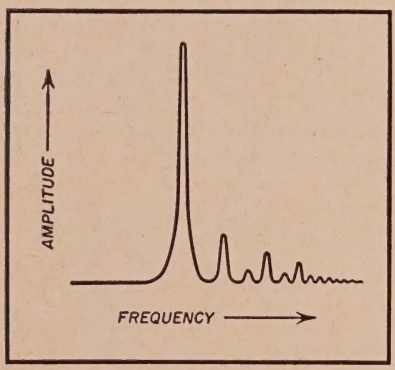


Fig. 8. Typical display from screen of sonic analyzer.

cathode ray screen is graduated in cycles per second along its horizontal axis, and in units of signal-component amplitude (millivolts or decibels) along its vertical axis. The fundamental and successive harmonics appear as pips of proportionate height. In the sample display in Figure 8, note that even-order harmonics are more pronounced than the odd-numbered ones.

In many applications, the visual indication and automatic tuning of the panoramic-type analyzer eliminates the tedious point-by-point checking necessary with conventional wave analyzers.

How this instrument accomplishes its action may be understood by reference to Figure 7. The complex signal to be investigated is presented by the input a. f. amplifier (A) to the balanced modulator (B). Output of the sweeping oscillator (G) also is presented to the balanced modulator. The oscillator frequency is swept recurrently by the reactance modulator (H) which in turn is driven by the sawtooth generator (J) through an isolating amplifier (I).

The output of the balanced modulator has a fixed frequency of 100 kc. for all input audio frequencies, between 40 and 20,000 cycles, scanned by the sweeping oscillator. This 100-kc. intermediate frequency is the sum of the input audio and sweeping oscillator frequencies.

The intermediate-frequency signal is amplified by the variable-selectivity stages (C and D) and the 100-kc. amplifier (E). For optimum resolution, the selectivity of stages C and D is varied simultaneously by selectivity control circuits K and L actuated by the sawtooth generator through an isolating amplifier (M).

Output of 100-kc. amplifier E is detected at F by a pushpull average-responsive circuit, amplified at N in a video amplifier, and applied to the vertical deflection plates of the cathode ray tube. The linear sawtooth voltage from generator J is applied to the horizontal deflection plates to provide a time base in step with the sweep (spectrum-scanning) frequency.

Action of this instrument is to scan the audio spectrum between 40 and 20,000 cycles, "catching" the fundamental and harmonics of a complex waveform applied to its input terminals, and to give a display of pips whose heights are proportional to the ampli-

tudes of the various frequency components and whose positions along the horizontal axis correspond to the frequencies of the components. For the vertical axis, a linear scale with a 10:1 ratio or logarithmic scales with 40 db (100:1) or 60 db (1000:1) may be selected by means of front-panel switches on the Model AP-1. The logarithmic scales allow readings to be made with greater accuracy and facility when there are wide differences in amplitude of the various components.

The Panoramic Model AP-1 Sonic Analyzer has a constant input impedance of 250,000 ohms. An input potentiometer is provided and is set to its maximum-gain position when absolute voltage measurements are to be made. Five input voltage ranges between 50 mv maximum and 500 v. maximum are provided, and each of these ranges is divided into seven scale ranges. For example, the 0.5 to 50 mv range may be subdivided into scales with the following full-scale deflections: 0.5, 1, 2.5, 5, 10, 25, and 50 mv. The audio spectrum, 40-20,000 cycles, is scanned at the rate of once per second. In the balanced modulator, residual harmonic products and residual cross modulation products are suppressed 60 db minimum. Hum in the instrument is suppressed 55 db below the maximum input voltage of any of the input ranges. The weakest second harmonic measurable at frequencies of 1 kc. and higher is 0.2%, at 500 cycles 0.3%, 250 cycles 1%, 100 cycles 5%, and 40 cycles 20%.

Resistance-Tuned Analyzers

The proper use of negative feedback can give an amplifier a relatively sharp bandpass characteristic. This principle has been explained previously in THE CAPACITOR. (See November 1952 issue). An adjustable, frequency-selective element in the feedback loop enables tuning of the amplifier continuously over a certain range. Thus, a feedback-type amplifier may be arranged for tuning within the audio-frequency spectrum.

This instrument would be useful as a simple wave analyzer, since it might be tuned successively to the fundamental and the various harmonics of a complex waveform, and the amplitudes of these components measured with an a. c. vacuum-tube voltmeter.

Figure 9 shows the skeleton circuit of a resistance-tuned wave analyzer. A circuit similar to this is employed in the General Radio Type 760-B Sound Analyzer. The tuned portion of the unit consists of a 3-stage direct-coupled amplifier (V_1-V_2-V_3) having flat frequency response in the a. f. spectrum. Negative feedback is supplied through the parallel-T resistance-capacitance null network comprised by C_1, C_2, C_3, R_1, R_2, and R_3. The negative feedback cancels the amplifier gain on all frequencies except the null frequency of the network. This single frequency therefore is transmitted readily through the amplifier, while all others are rejected. By varying all three resistances (R_1, R_2, and R_3) simultaneously, the null frequency of the parallel-T network may be varied continuously, and the amplifier accordingly tuned. Capacitors C_1, C_2, and C_3 may be switched simultaneously in groups to change bands.

Just as the heterodyne wave analyzer resembles a superheterodyne radio receiver, the resistance tuned analyzer is comparable to a tuned radio-frequency receiver. The resistance-tuned circuit has the disadvantage that it does not provide the high degree of selectivity of the heterodyne-type analyzer. Rejection is about 40 db (100 times down) per octave. This limits the smallest harmonic component measurable to about 1% of the fundamental frequency. Nevertheless, for many applications, the comparative simplicity and small size of the resistance-tuned analyzer suit it for use where harmonic amplitudes are rather high.

There have been described in prior literature several resistance-tuned amplifiers other than the specific circuit shown in Figure 9. Examples are: **Tunable A. F. Amplifier** by Oswald

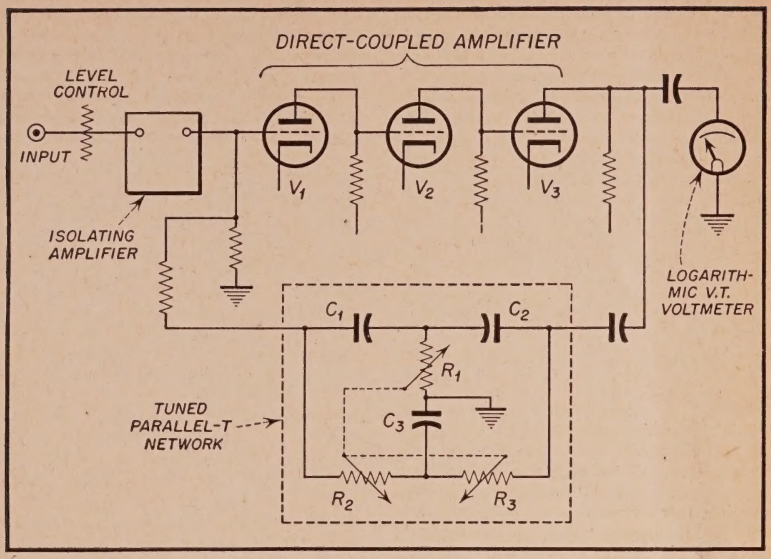


Fig. 9. Resistance-tuned wave analyzer.

G. Villard, Jr.; ELECTRONICS, July, 1949, p. 77. **Sine and Square-Wave Generator Selective Amplifier** by Vin Zeluff; ELECTRONICS, December, 1950, p. 120. **Independent Control of Selectivity and Bandwidth** by Oswald G. Villard, Jr., ELECTRONICS, April, 1951, p. 121. All such circuits are useful to some extent as wave analyzers but, in general, are restricted to about 40 db or less of discrimination between fundamental and harmonic components of a complex wave.

Voltmeter Search Method

The so-called "search" method is employed in laboratories occasionally for practical wave analysis when a conventional analyzer is not available.

In this method, the complex signal and the output of a laboratory-type, variable-frequency, sine-wave audio oscillator are applied simultaneously to a square-law vacuum-tube voltmeter. Usually, the output circuits of the two signal sources are connected in series. The oscillator is tuned successively to the fundamental frequency and to the various harmonics. As each frequency is approached, the pointer of the voltmeter pulsates to indicate the resulting beat note. The frequency component may be identified from the setting of the oscillator dial, and the swing of the meter pointer is proportional to the strength of the component.

While this method is relatively simple, it is somewhat limited in use. Square-law v. t. voltmeters are not common, the output waveform of the oscillator must be exceptionally pure, and measurements are restricted to signal amplitudes within the square-law response of the voltmeter.

Interpretation of Readings

When checking the output of any device, such as an oscillator, generator, or amplifier, for distribution of frequency components, the device must be terminated in its normal out-

put load impedance, and the input of the wave analyzer shunted across this load impedance. The technique is to tune the analyzer successively to frequencies f_1, f_2, f_3, f_4, etc., corresponding to the funadmental, 2nd harmonic, 3rd harmonic, 4th harmonic, etc., and to read the corresponding signal-voltage levels as E_1, E_2, E_3, E_4, etc.

The percentage of any harmonic (f_n) in terms of the fundamental f_o then is equal to 100 (E_o/E_n). The E terms here represent the amplitudes at the indicated frequencies. The wave analyzer gain must be set to a level (E_o) such that the smallest harmonic voltage component (E_n) will give a readable deflection on some lower scales of the meter.

If the wave analyzer gain is set for a deflection of 100 (volts or millivolts) at the fundamental frequency, the meter then will indicate harmonic amplitudes directly in percentage of the fundamental, and no calculations will be required.

Before checking an amplifier or network, the sine-wave oscillator to be used to supply a test signal to the amplifier first must be given a wave analysis at each test frequency and at each setting of its output control. Each harmonic amplitude of the oscillator then must be subtracted from the corresponding measured harmonic amplitude later obtained for the amplifier. In this way, the inherent distortion of the oscillator, however slight, is taken into consideration.

The total harmonic distortion of any system is the r. m. s. sum of the various harmonic amplitudes (E_2, E_3, E_4, etc.) divided by the fundamental amplitude (E_1), thus:

$$(1) \quad D = \frac{\sqrt{E_2^2 + E_3^2 + E_4^2}}{E_1}$$

A thoroughgoing wave analysis of an audio amplifier requires that (1) the amplifier be terminated in its normal load, which should be the loudspeaker if the amplifier commonly works into a speaker, (2) the complete test be repeated at as many fundamental frequencies as practicable throughout the normal frequency range of the amplifier, and (3) the entire test be repeated at each of the important settings of the volume and tone controls.

Supplementary Uses of Wave Analyzer

Because the wave analyzer is a sharply-tuned device, it is useful as a direct-reading frequency meter throughout its tuning range. The unknown frequency is applied to the analyzer input terminals and the dial rotated, starting at the lowest-frequency setting. The first resonance then indicates the frequency which may be read from the analyzer dial.

Hum studies may be made by connecting the analyzer input to the suspected circuit and tuning the instrument to the powerline frequency, its 2nd and 3rd harmonics, and noting the strength of the hum signal, if present.

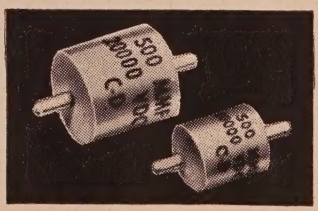
As a highly-selective v. t. voltmeter, the wave analyzer finds application as a sharply-tuned detector for use with impedance bridges and in checking wave filter characteristics.

In studies of intermodulation distortion, two signals (a low frequency f_1, and a high frequency f_2 suitably selected with regard to frequency and relative amplitudes) are applied simultaneously to the amplifier or other system under test. The wave analyzer then is connected to the output of the system, and the output waveform inspected for sum and difference components of the two input-signal frequencies. The wave analyzer not only shows the amplitudes of these beat-note products but also indicates the strength of harmonics resulting from operation of the amplifier during the process. The test may be repeated with different combinations of low- and high-frequency test signals.

C-D's Tiny Mike

takes 30,000 volts with a grin!

The famous ceramic body made by C-D with an original engineering job inside and out! More dependable, longer lasting than any previous TV high-voltage ceramic capacitor! Can be used at *full rated voltage*, because it's *conservatively* rated for DC flash test up to 2x rated working voltage!



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South Plainfield, N. J.

1910-1953

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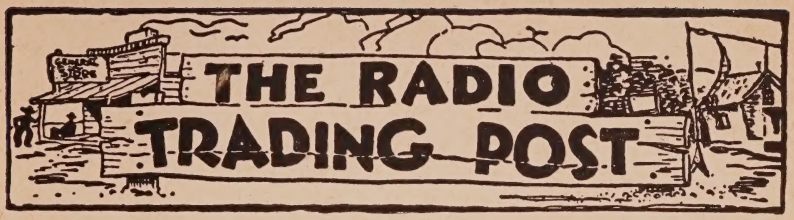

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SALE OR TRADE — Model BK-411 Brush Soundmirror tape recorder, Howard model 450A communications receiver complete with separate speaker, old Buick car radio and Pontiac all in good condition. Edgar Lefferson, 405 S. Walnut St., Bloomington, Ind.

FOR SALE — U. S. Television Co. electronic sweep generator, model TVFM, 10 to 100 MC. Used but in good condition, $50 or will trade for a new high voltage or oil condensers. J. Schachter, 51 W. 3rd St., New York 12, N. Y.

SALE OR TRADE — One Varityper, 7 fonts of type and extras. Just rebuilt, want $325 or swap for marine radio for pleasure craft. R. M. Hilton, 4123 Bagley Ave., Seattle 3, Wash.

SERVICE — Will assemble all electronic kits for from $3 to $8, including oscilloscopes and transmitters. Write for estimate before shipping kits. Harry Conover, Jr., 100 Walnut St., Bordentown, New Jersey.

WANTED — Used hearing aids. Name price, make, year, and condition, also hearing aid parts, schematics, books, etc. Marvin J. Wolman, 23 Caton Drive 108-A, East Syracuse, N. Y.

WANTED—Western Electric 555 driver. Must be in good shape and reasonable. Write details to H. K. Garlock, 2311 Strathmore Rd., Lansing 10, Mich.

SALE OR TRADE — Model engine, Class C, nearly new, has all new ignition parts, plus plug wrench, gas tank, wood and aluminum 14" props, matched flywheel, abundant instructions. Need test equipment. Paul Bateman, 710 West St., Emporia, Kan.

FOR SALE OR SWAP—Radio, TV tubes and parts—for new American flyer train sets or rolling stock, or 8mm-3 lens turret camera. Send your list of needs. B. Blatt, 8 First St., Haverstraw, N. Y.

WANTED—Navy or Army Synchros, Selsyns. Will buy all types 1F, 1G, 5G, 5CT, 5DG, etc., also want Resolvers, Autosyns, Torque units, 400 Cycle motors, generators, D. C. Motors. Will pay highest prices. C. L. Wilson, 1096 Goffle Rd., Hawthorne, N. J.

FOR SALE—Hallicrafters 572; 4-band portable rec. $45 or best offer. George A. Liptak, 58 Wonham St., Clifton, N. J.

WANTED—Good used typewriter, 16mm silent movie projector, and films of all kinds. Will swap first-class mailing and addressing service or pay cash. Frank H. Snyder, Lock box 1075, Troy, N. Y.

WANTED—1939 Buick auto radio new or used., also TV set Westinghouse model H303P4. Louis De Marco, Jr., 2 Clay St., New Haven, Conn.

WANTED—Multi-band 500w antenna tuner and VFO, in good condition; Harvey-Wells TBS-50C, if priced reasonable. Will trade SX-15 and SCR-625 mine detector or anything of value. Norval Wallen, Mansfield, Mo.

TRADE OR SELL—Wheelco model 310 portable potentiometer. For complete Stereo-Realist outfit or for cash, also model 201 Vibrotest. E. Marra, 1337 Kenilworth Ave., Lakewood 7, Ohio.

SELL OR SWAP—BC 403E Oscilloscope, MO-1 xmtr-receiver, Teleplex code machine, 35mm Retina camera, 10 meter mobile rig. Excellent condition. Leon DeLaneuville Convent, La.

FOR SALE OR TRADE—Philco No 0-88 sig. gen.; Biddle Jagobi Chronometric tachometer; high voltage transformers; Armstrong Dies; Holland damper control motor; Leece Neville 60-80 amp. auto gen. J. Dillon 153 Hylan Blvd., Staten Island 5, N. Y.

WANTED—Feiler Stethoscope TS-7. W. E. Schwenzer, 3619 Peach St., Erie, Pa.

WANTED—Used books in good condition on radio by Terman, Glasgow, Everritt, Eastman, etc. Quote lowest price. J. W. White, 5311 Hamilton St., Rogers Heights, Md.

WANTED—TV sets: RCA 630TS, Stromberg Carlson TV-12, or a Hallicrafter T54 or 505. Must be reasonable. Wayne A. Kuschel, 9305 Pennsylvania St., Fairchild, Wash.

FOR SALE OR TRADE—30 Channell 7 Yagi's, 5000 ft. 4 conductor lead for Antenna Rotor, and Hickok sig. gen. model 610A. For information write Vincent's, 1135 Main St., West Warwick, R. I.

FOR SALE—A-1 shape, Meissner Analyst model 9-1040 complete with instructions, $50; EC-200-C Precision sig. gen.; instructions, $40. Supreme tube battery multitester in one unit, 504-A, $40. Heathkit oscilloscope O-4, $40; N. C. National communication rec., $50. James B. Bradley No. 2, Box 158, Gate City, Va.

TRADE—10" Philco and 12" Hallicrafter TV, combination record changer, and recorder unit. Electro voice dynamic mike model 635, crystal mike. Want wire or tape recorder or photo equipment 35mm. Louis Venturelli, 224½-21st. St., Brooklyn, N. Y.

SELL OR SWAP—For 7" or 10" TV set in perf. working order. '41, '42 Buick radio ready to install. '38 Ford radio Stewart-Warner auto radio. Best offer or best TV set offer takes them. Phillip C. Haley, P. O. Box 21, Dunkirk, Ind.

SALE OR TRADE—Heath VTVM just built. Needs final calib; instr. sheets, etc. $20, or trade automatic pistol, like new, 25 cal. for large cal., good cond. Send stamp for list. W. F. Onder, Rt. 2, Box 193, Arnold, Mo.

SELL OR SWAP — RCA-M1-7802 A., ten tube mobile rec. with dynamotor power unit, loudspeaker, connecting cables, and instruct. man. Covers 10 meter band. $25 or swap for 75 meter mobile rec. or conv. C. E. Metzger, P. O. Box 1314, Lake Charles, La.

SELL OR SWAP — Like new Rider Amplifier vol. 1., with "How It Works" $18. or swap for test equip. Aug Radio Service, 2230 S. Winebiddle Ave., Pittsburgh 24, Pa.

WANTED—5691, 5692, or 5693 radio tubes. Will buy other needed tubes and equip. if you will submit list. B. N. Gensler, 136 Liberty St., New York 6, N. Y.

WANTED—"200 Meters and Down"; state condition of book and price in first letter. W. C. Ellsworth, Westinghouse Radio Stations, Inc., 1625 K St., NW, Washington 6, D. C.

FOR SALE—Heathkit cond. checker, with test leads & instrument man., also Heathkit sig. gen. complete with probes & instrument man. Cash only. Ship express collect, $26 takes both. T. Englert, 1601 France St., New Orleans 17, La.

FOR SALE—Sig. gen. I-198A, $15; Frequency meter BC 438, $20; SCR-522, $50; Phase Inverter MC-411A, $4. Complete with tubes. Want tube tester, LCR checkers; thyratrons. Paul Kilpatrick, 1030 Curtis St., Albany 6, Calif.

FOR SALE OR TRADE—75W B&W Turrett coil assembly, type JTCL; 115w UTC modulation trans. model S21, like new. Used pair modulation transformers 75 w. Motorola police receivers 8 tube for I. F. strip for mobile converters. Harlan Dewitz, Wisner, Neb.

FOR SALE—Riders Vol. 12, 16, 18, like new. Ship for best offer. Arch L. Campbell, 78 Main St., Dublin, Pa.

WANTED—BC-610 transmitter. Give age, model number, condition, and lowest cash price. A. W. Nevers, 402 S. Main St., Mt. Pleasant, Iowa.

TRADE—Ionization guage testing unit, used for electronic lab. work, 5 tube. Want: Small TV radio test equipment or key cutting machines. W. H. Norman, 112 Douglas Ave., Rockwood, Tenn.

SWAP—89 miscellaneous back issues of C-D Capacitor, perf. cond. Vol. 9, No. 6, (June, 1944) to current. Will exchange for NRI or Sprayberry course. Weissman, 224 Ross St., Brooklyn 11, N. Y.

FOR SALE—Hallicrafter S38B—new cond. —$30. John C. Cain, 10229 Capitol View Ave., Silver Spring, Md.

WANTED—NRI manual No. 14x-1. Name your price. Armen Hanjian, 102 Floral St., Roselle, N. J.

SELL OR SWAP—Perfect RME HF 10-20 converter; 3BP1 C. R. tube; 30w. fone/cw rig completed as part of NRI course; 304TH & 304TL tubes, like new. Jesse W. Stonecipher, 1610 W. John St., Champaign, Ill.

WANTED—Recent correspondence courses, any field. Will make reasonable offer. Frank Valentino, 1714-76 St., Brooklyn 14, N. Y.

FOR SALE — 10" Magnavox & Motorola table model TV sets—$49 ea.; 7" Motorola TV table model—$30. Jones Radio, Douglassville, Pa.

FOR SALE—McMurdo Silver Vomax, model 900 vacuum-tube voltmeter., $25. Maurice Superville, 4514 Blossom St., Houston 7, Tex.

FOR SALE—100 6AG5's in bulk carton; BC-728A, BC-603, BC-604D, GP-7 tuning units, gen. radio 200B Variac. Best offer. S. Consalvo, 2507 Southern Ave., SE, Washington 20, D. C.

FOR SALE—Coin operated radio, 6 tube, good condition, $15 ea. Brown Taylor 1307 Vultee Blvd., Nashville, Tenn.

WANTED—National FB7 coils for 15 and 20 meters, also 813. Will pay cash or have tubes, parts, etc. including 330 kc. crystal and six 9003's. Jim Chatham, 539 Westview Dr., Winston-Salem, N. C.

SELL OR TRADE—Gonset tri-band con. and noise silencer, $40. Silver model 906 sig. gen., $65. H. L. Enstrom, 529 S. Villa Ave., Villa Park, Ill.

SWAP OR SELL—Supreme Audolyzer model 562; 200 tubes, like new; odd parts. Send for list. Rudolph P. Fannon, 7607 Kittyhawk Ave., Los Angeles 45, Calif.

TRADE OR SELL—1941 Buick radio 980, 620 for Plymouth '40 radio; good condition; odd tubes. Want Plymouth heater. David V. Chambers, 255 Long Lane, Upper Darby, Pa.

FOR SALE—Amplifier 10w with turntable and mike, $29; GI. TV tuner, $3; 3-way portable, $12. R. Wilson, 87-73-172St., Jamaica 32, N. Y.

FOR SALE—Snaider Auditorium P-520 TV Console, 20 x 26 picture, 5TP4, lens, mirror, rear projection screen system. Excellent 37-tube circuit. Orig. list, $1495. Price $198. Write for specs. N. P. Forcier, Essex St., Middleton, Mass.

TRADE—NRI radio & TV comm. course, complete for National 1-10 rec, coils and pwr. supply or equiv. R. Hintze, 1045-D Allen Ave., Glendale 1, Calif.

TRADE OR SELL—Complete GE model 910 proj. TV; Sam's Photofacts 1 thru 100; Rider's vol. 12, 14; assorted tubes. Want camera, projector, binoculars, VTVM. Theodore F. Sassi, 190 Warwick Neck Ave., Warwick, R. I.

TRADE OR SELL—Leica camera IIIC. Need Sam's folders, Simpson 479, Jackson TVG-2, and Hickok 650. G. H. Swiska, 109 E. School St., Woonsocket, R. I.

FOR SALE—Heathkit Scope model 0-6, like new, $35 or communications Rcvr. Leo Perlmutter, 1 Fisher Dr., Mt. Vernon, N. Y.

FOR SALE—Hallicrafter HT9 xmtr, fully filtered and screened (shielded) for TV1 with coils for 10-20-40-75 80 meters, $275 F. O. B. complete. Evyn H. Walton, 250 Kensington Place, Marion, Ohio.

TRADE—Like new Web-Cor tape rec. model 210, 14 7" reels plastic base tape, 8 recorded with music, 6 unused. Best offer over $100. Transportation collect. Will swap for good German camera, with fast lens. Joseph D. Copeland, 66 Clark St., Portland 4, Me.

FOR SALE—Like new, 70 lb. air compresser with 15 gal. tank and electric motor, $60. Walter Rygiel, 151 N. 9th Ave., Manville, N. J.

FOR SALE—Like new, RCA WR—39c TV calibrator, $200. Guaranteed for year by company. A. Torres, c/o Columbia Radio, 1254 Amsterdam Ave., New York 27, N. Y.

TRADE—National NC-100A rec; National 8" PM spkr, excellent cond., Chicago Webster Wire rec. model 178, perfect. Want manuals, test eqpt., small TV set, or what have you? E. DeCobert Jr., 609 Henrietta St., Gillespie, Ill.

WANTED—Surplus Jeep, four-wheel drive. Will buy but prefer to trade for amateur service shop or other electronic equipment. Bob Burnside, 150 Mercer Ave., Hartsdale, N. Y.

WANTED—Technical Manual for Radio receiver R-44/ARR-5., also Handbook of Maintenance Instructions for radio receiving set R-44/ARR-5. Willard W. Davis, 10 Temple St., Gloversville, N. Y.

FOR SALE—Radio controls, or relays, motors, miniature lamps and experimental and model-builders. All inquires answered. Morris Moses, 1720 Union St., Schnecetady, N. Y.

SWAP—Pair of complete telephones; TV ant. 13. Radio altimeter; BC454B; BC 455B. rec. Meters, TS3 Feiler sig. tracer, for good used TV rec. Thomas R. Rohland, 314 Spruce St., Huntingdon, Pa.

FOR SALE—Super Skyrider SX-16 aligned, perfect cond., less spkr., $40; Thordarson xformer T-19P67—1360VA 4980 Vct. 4250 Vct. 500 MA DC. 115v. AC 60 cycles, like new, $40. FOB. Ronald W. Bissett, 661 Parker St., Roxbury, Mass.

FOR SALE—Housecleaning: James Knight's Frequency Standard, Vibroplex, 25 amp. autoformer, meters, command transmitters, and rec., transmitting tubes, tank condensers, power and filament transformers. Write for list. Harry Williams, Pleasant Hill, Mo.

WANTED—Johnson Viking Transmitter in good cond. Trade complete indoor—outdoor PA sound system—two high fidelity spkr., one cabinet, insulated stands, one mike. Ideal for club. F. M. tuner. Thomas G. Ravesi Jr., 99 Rockridge Rd., Waltham 54, Mass.

FOR SALE—Army type tube tester, model 501 also one Bliley crystal for 130035.7 KC. Robert Teall, Litchfield, Mich.

FOR SALE—Radio city tube tester model 802; Rider man., vol-1 to 12. In good cond. Best Offer. C. J. Schexnayder, 200-Shreveport Ave., Port Arthur, Tex.

FOR SALE OR SWAP—Supreme Model 599-A tube and set tester. Tests latest tubes including 9 pin miniature. John G. Perkovich R1, Box 150, Waldo, Wis.

FOR SALE—Mounted RA-38 Rectifier, input supply 115v, 60 cy. single phase. Max. filtered output 15,000 v. d. c. at 0.5 amp. Transtat regular permits continuous variation of the d. c. output voltage from zero to max., like new, $350. F O B. Chromatic Television Inc., 703—37th Ave., Oakland 1, Calif.

FOR SALE—Presto K-80 portable disc recorder and playback. Make offer. John Whitacre, 407 N. Wash., Lansing 30, Mich.

TRADE—Antique foot power organ, fair cond. For Sam's and Riders Man., or what have you? E. F. Harman, Box 408 Stroud, Okla.

FOR SALE—Heathkit cond. checker model C2, home-built, perfect condition, $20.50. COD. DeNoe Radio Service, Dodgeville, Wis.

WANTED—National "NHU" high frequency receiver. State price and condition. Harry Williams, Pleasant Hill, Mo.

SALE OR SWAP—BC459A, like new, $20; T19/ARC5. 3-4 mc, like new, $25. Want Mon-key—Gonset conv.—Signal Shifter. Lewis Daufman, 5213 Ventnor Ave., Ventnor, N. J.

FOR SALE—In original carton, Sylvania 16AP4A picture ube. Make cash offer. W. R. Jones, 1094 E. Confederate Ave., S. E., Atlanta, Ga.

SWAP — Standard brand, guaranteed tubes, test eqpt. for good 7" or 10" TV set in good working cond. Consalvo, 2507 Southern Ave., SE, Washington 20, D. C.

FOR SALE—Riders vol. 1 to 5; RCA Service Notes 1931 to 34, 38, 40; Philco 1939, 40; Supreme 1939, 42. Best offer shipped C. O. D. Stephen Barniak, 2426 Perot St., Philadelphia 30, Pa.

FOR SALE—Conn Trumpet with case, good condition, $60., or trade for TV field strength meter. Savages, Granby, Mo.

FOR SALE—Motorola auto radios one of each to fit any car—one manual, $50, one push button, $60. T. Krotal, 1430 E. 55 St., Cleveland 3, Ohio.

FOR SALE—Dynamotor—6V. input—425V. at 375 ma output., new cond., $30, FOB. Larry Dillin, 6616 Olcott St., Tujunga, Calif.

FOR SALE—Eico scope 3 mos. old $45; Rider's manuals 1-15, $9 ea.; pocket gen., list 32—$15. J. Maugeri, 166-75 22 Ave., Flushing, L. I.

WANTED—8mm. projector, state make, price and condition. Will swap for radio or TV parts. Dambach Electric, Silver Creek, N. Y.

FOR SALE—QST mags—1945 through 1952 in cardboard binders—clean perf. cond. Best offer. C. G. Stuart, 141 Whiting St., Toledo 9, Ohio.

WANTED — APN-4, BC-612, Test Eqpt. Have U. H. F. tubes and parts, 1/2" drill. Write for list. Robert A. Goyer, P. O. Box 33, West Boyleston, Mass.

TRADE OR SELL—Bench vise Wilton 4½" with pipe jaws, $25.; model 8 L. C. Smith typewriter, $20.; Trimm headphones excellent, $4; No. 33 tape, $1 roll. Need VFO., xtal mike, ham eqpt. Simon B. Budnik, 1-Taft Ave., Lancaster, N. Y.

SELL OR TRADE — Hickok gen. 288x scope 305, tube checker 532; C-A capacitor checker BF50; Electronic Mfg. Co. VTVM 100 with Peak to peak AC probe. A-1 condition. Want hi-fi audio parts and astronomical telescope. The Radio Shack, 1602 W. Pratt St., Baltimore 23, Md.

SWAP—Two G. E. phono motors, model 5SY1A160-amps. 8-cyc. 60-Ph.1-V.110-3/4—RPM 78.26 for a late model VTVM. Landry's Radio Shop, 2600 Pauger St., New Orleans 16, La.

FOR SALE—Philco tube tester; Hickok VOM 2500 O. per V., Solar Capacitor tester, $125. T. Jensen, 5427 Homer Ave., Cleveland 3, Ohio.

WANT — 3KP4 TV. tube. Robert Bilek, 10407 Grandview Ave., Cleveland 4, Ohio.

SELL OR SWAP—7" Automatic port. TV., model 707, good condition., want sweep gen. late mod. Eico or Heathkit. Adam W. Miller, 381 Baldwin St., Meadville, Pa.

WANTED—Pre-war Scott radio. Trade or sell radio and transmitter components, test eqpt. Send for list, also want hi-fi audio components. John Darrow, 35 So. Biggs St., Belleville, Mich.

TRADE OR SELL—Health scope exc. cond., $40; BC191 tuning units 6-8-10-26 $2. ea; 2 door trans-rack cabinet 38 x 20-$10; 200 old type radio tubes—$18. Want tape recorder. W. J. Davis, 4738 Adenmoor Ave., Long Beach 11, Calif.

SELL OR SWAP—Japanese camera with carrying case and lens filter, $10; f/3.5 lens, takes 120 film. Will accept old FM radio in trade. P. Gelzinis, 7821 Revere St., Philadelphia 15, Pa.

FOR SALE—G. E. automatic time switch for sign or motor, with built-in switch-on-off type 9—110V.—60 cyc., waterproof housing, perf. cond., $20. takes it. J. G. Schaf, 215 Clinton Ave., Albany 4, N. Y.

FOR SALE—S X 28 Super Skyrider; 12" Jensen PM hi-fi; Webster Chicago 357-27; Ebco 10BP4. W. Fernandes Vet's Housing C-25, Lido Beach Rd., Lido Beach, L. I.

SALE OR TRADE—Magnavox auto portable record changer 42H; Eico tube tester 625; Simpson roto ranger VOM; Hallicrafter S40; Back issues of service mag. '48 to '52; rifle. Want Sam's manuals 45-90. George Stout, 2110 7th Galena Park, Tex.

SWAP—Rack and panel 450, 1 complete trans. 813 final 250W. Class B 811's mod. for HQ 129 X or SX71 rec. BC 522, etc. Emery McFarland, 1829 Walker St., Cincinnati 10, Ohio.

FOR SALE—Thordarson plate transformer T-45361, 190-210V. PRI., 1660V. 315 MA. Sec.; T-45360 Fila. transformer, 190-210V. PRI., 5.2V. at 12A, 5.1V. at 6A, 2.6V. at 10A Sec.; T-521 Choke, 6-21 HY 600 MA.; N. R. I. electronic multitester, no case. Harry Wood, 451 Manor Rd., Hatboro, Pa.

WANTED—Antenna coil part No. 7236383 for Oldsmobile 982126; also tuning volume and tone control knobs for same set. A. Brace, 32-09-44St., L. I. C. 3, N. Y.

SELL OR SWAP—RCA wavemeter model. AW 5011 21 to 40 MC Nat'l type N dial 270 deg. GR freq. meter var. cond.—Ferret model 610 square-sine wave gen. 20 to 24000 cps. Want 16mm films of all kinds, projector—or what? R. N. Eubank, 1227 Windsor Ave., Richmond, 27, Va.

SELL OR TRADE—Hickock 305 scope, chanalyst, condenser tester, Vomax sig. gen. antennae compass, tube checker, 10 Riders, etc. For boat, deep freeze or—complete shop with $300 stock of tubes plus other stock. W. Fox, R2, Clinton, Ind.

WANTED—Used turntable motor, about 1/30 hp. Must be Hysteresis Sync, or complete turntable, same requirements, also Markel "playmaster" record changer, one speed. Write description. Paul Carranza, 722 W. Commerce St., San Antonio 5, Tex.

WANTED—Rider's 21, 22 and 23. State condition and price. Sell or trade Crossman repeating air rifle and "Diana" German Luftgewehr. G. T. Mackenzie, 1948 Lewis Mt. Rd., Charlottesville, Va.

SELL OR TRADE—1/4" drill outfit, VOM, No. 180 Webster recorder; 15" portable wheel balancer A1 cond. Need good commun. receiver. John Garsia, 408 First St., Corning, N. Y.

SALE OR SWAP—Vest pocket volt ohmeter; sig. gen.; radio chassis, less tubes. Want wrist watch; camera lenses F.2-9 F.2-8. Enclose stamped addressed envelope. J. Bondaruk, 410 E. 13th St., New York 9, N. Y.

FOR SALE—Radio-electrical appliance repair shop, paint store, PA rentals, only speaker reconing business within 120 miles. TV coming soon. Sell for wholesale cost fixtures, stock, equipment, approx., $5,600. See or write, Sweeney's Radio & Reconing Service, 922 W. 5th Winona, Minn.

FOR SALE—Rider manuals, volumes 1-4, like new, $10. Joseph J. Blaha, 3690 Normandy Rd., Shaker Heights, Ohio.

WANT—Tuning slugs or complete permeability coils for airline radio model 64BR—1205A. H. Falkowski, Box 207, Springside, Saskatchewan, Canada.

FOR SALE—Simpson model 305 tube tester in good cond. Will test most tubes,$15. Melvin Saur, Kent City, Mich.

FOR SALE—Philco car radio, like new, UNG-400, $20; Utah 12" Hi-fi PM dynamic spkr., $5.50 P. P. Harry Kay, Rte. 2, Box 255, Imlay City, Mich.

FOR SALE OR TRADE—2 UTC linear standard output xfmrs models LS-60-A and LS-6L1; UTC-VM3 Varimatch 100-250W. output mod. xfmr. Like new. Best offer or trade for TV and radio rec. tubes, Sam's or Riders TV manuals. H. D. Stone, 2449 W. Cortez St., Chicago 22, Ill.

FOR SALE—Guitar amplifier in nude cabinet. Tube compliment 12SJ7, 12SQ7, 50L6, 35Z5. 8" PM spkr., mike input and two PL-55 plug jacks Volume, and tone. $20. Howard Clewett, 2732 Sheridan Way, Sacramento 21, Calif.

WANTED—60 cycle Navy Selsyns. Will pay $35. for 1DG or 1DF; $30 for 1F, 1G, 5G, 5F, 5CT; $25 for 5DG. Subject to inspection. Will advise price on other types. Electro, 110 Pearl, Boston, Mass.

WANTED—Hallicrafters HT-9 any cond. State price. Have model airplane engine for sale. Ray Pollard, Jr., 1474 Shelby Drive, Memphis 16, Tenn.

FOR SALE—RCA 30kV. flyback transformer with matching yoke 5TP4 tube (Projection) 2-6AS7 and television proj. lens all for $40. H. Bergh, 1583 E. 96th St., Brooklyn 36, N. Y.

SELL OR TRADE—Two 833A's, Four 845's, 813, used, but fine for ham xmtr; Ghirardi's Radio Physics course. Want test equip.; sig. gen.; scope; VOM "grid-dip" meter or cash offer. Walter Peters, 511 N. Franklin St., New Ulm, Minn.

FOR SALE—1150W. Burdick Diathermy Machine model SWDX-80, xtal controlled. Easily converted to ham transmitter. Cost $800. Best offer—FOB. Julius Wolff, 987 Hegeman Ave., Brooklyn 8, N. Y.

FOR SALE—4 speakers 12" mounted in parabolic baffles; 2 RCA's (Kainer steel-aluminum)—all with matching transformers; RCA booster amplifier with single mike and phono channels. Eugene M. Hess, 3339 Oakland Rd., NE., Cedar Rapids, Iowa.

WANTED — Desperately need schematic and parts list for RCA Victor model R-98 "Victrola" phonograph. Will pay. Richard L. Evans, Jr., Box 156, Ambler, Pa.

FOR SALE—Hallicrafter's HT-17 transmitter with all coils and panel meter, like new $35. Pat E. McGee, Raritan, Ill.

SELL OR TRADE—8mm Keystone projector, model C-8 with case. Want VTVM. Sidney Goldstein, 775 Linwood St., Brooklyn, N. Y.

WANTED—Recording of WWV 440 at all three speeds, for setting DC turntable speed. A. H. Taylor, Read Island, B. C., Canada.

FOR SALE—4-81's, 10, UX874, 32L7, 25B8-GT tubes, 25% off. Must take all. Want band saw, metal cutting lathe. Saxton's Radio & Elec. Service, Rte. 1 Pontiac,Ill.

FOR SALE OR TRADE—Weston VOM model 689 type 1-F, good cond. leather case. trade for Precision 840 VOM or cash. Radio Service Center, 1767 Johnson City Hi'way, Kingsport, Tenn.

SWAP—NRI radio and TV course less experiments, for Sam's Photofacts or radio gear elect. William P. Dail, Rte 2, Box 220-B, Ayden, N. C.

WANTED—16mm camera—32-20 Winchester rifle. Have test eqpt., 8mm camera Meissner recorder radio & PA. All letters answered. Mackey's Radio & TV Service, 327 N. Spring St., Tupelo, Miss.

FOR SALE—Small modulation transformers; output transformers to line or voice coil; transmitting tubes, etc. Send for list. Clarence F. Fanning, P. O. Box No. 263, Lenexa, Kan.

SELL—Merkle-Korff 30 rpm Flexo action motor, $3.50; 2 industrial condensers 2 mfd 1500V., $3.50 each; industrial condenser 2. x 2. mfd 1X500V., $4., 2 WE 113-A retard 30. Henry, $2. each. Riddell, Box 1930, Chicago 90, Ill.

WANTED—Signal Corps supply catalogs known as Sig 5, 11-2; technical manuals, BC-610-E, 614-E, 1306, 348, 221, ART-13, TCS, PE-237, GN-58, Selsyns, ARC-1, APN-9, APR-4, 5ax, test eqpt. Tom Howard, 46 Mt. Vernon St., Boston 8, Mass.

SALE OR TRADE—Portable power pack, 2000-OPV. Shurite 3 mil meter, both in good condition; radio physics course, modern radio servicing by Ghirardi; Radio Service magazines, Jan. '49 to Nov. '50. Want usable RF gen. or tube checker. Ray M. Davis, Box 94, Pearl, Ill.

WANTED—Wholesale radio parts supply house devoted to the distribution of name line franchises, such as Tung Sol, Alliance, Cornell-Dubilier, etc. A. R. Davis, 318 Erie St., Toledo, Ohio.

WANTED—APR-4, etc., APS's, ARC-1, ART-13, BC-348, 221, etc.; TS-12, 13, 35, 45, 120, 146, 155, 173, etc., particularly Microwave eqpt.; G-R, Ferris, L&N, etc., units; 723A/B, 3C22, other tubes. Quick cash, or trade cameras, film, TV, ham gear (304TL's etc.). Littell, Farhills, Box 26, Dayton 9, Ohio.

TRADE OR SELL—Cameras, Ciroflex Reflex model "D", 35mm Retina 1A (F3.5, latest model) complete, like new. Need commun. recvr, NC-57 or similiar, also have 3" Weston meters, tubes, radio parts. I. Gurshewitz, 147 Chester, Brooklyn 12, N. Y.

FOR SALE—RCP model 668 VTVM in original carton.Cost $80. No reasonable offer refused. Bernard Gerson, 969-43 St., Brooklyn 19, N. Y.

FOR SALE—Eico-oscillocope; sweep sig. gen. tube checker; battery eliminator and charger; Precision E200 sig. gen.; 2 auto radios. Make reasonable offer. Joseph Clundt, 158 Linden St., Brooklyn 21, N. Y.

FOR SALE—RCA Senior Voltohmyst WV-97A, like new—in warranty. Probes, manual complete, $60.75. A. H. Steinberg, 18-24 Jordan Rd., Fair Lawn, N. J.

FOR SALE OR TRADE—A superregenerative TV checker, described in Oct. 1952 Radio and TV news, excellent cond., $20. Trade for Heathkit model C-3 cond. checker, or? Norman J. Nelson, 1916 Dupont Ave., So. Minneapolis, Minn.

SALE OR SWAP—Riders manuals 2 thru 13, $65 or make offer. Want ham eqpt. E. Yeager, 5302 W. 57th St., Mission, Kan.

FOR SALE—BC.223 transmitter & MG set, 2-1 K. W. Butterfly condensers; 2. 1 K. W. Pr. supplies. Many other items tubes, etc. Send for list. Ward E. Dean, Box 16, Martin, Mich.

WANTED—SW3 Band spread coils for 80 meters. Will sell. Bud 1729 Vernier dial and 20 meter 75W. end link coils; Antenna tuner in Bud cabinet, with 10 and 20 meter 150W. center link coils. A. Bogart, 451 Oak St., Emporium, Pa.

SALE OR TRADE—Triplett sig. gen.; textbooks; Nilson's Master Course in Communications for Scope. Raymond Julian, 337 So. 3rd St., Steelton, Pa.

TRADE—Hallicrafters S-20R excellent cond. Also BC-453 Q-fiver. Want TV set. State model and cond. Gerald Sabin, 34 W. Esther Ave. Orlando, Fla.

WANTED—Speaker for GE model F107 with output transformer on same. Stewart Rivers, 1533 So. 53rd St., Philadelphia 43, Pa.

FOR SALE—Old speakers, parts, and tubes for discontinued radios. All letters answered. C. L. Dennis, 12 Terrace Ave., Walton, N. Y.

SWAP—1952 TV set, 17 in. table model in working order, for Eastman 16 MM. movie projector (Kodascope) model A., 30 watt amplifier made by Rouland, complete with crystal mike, speaker, and tubes. Channel chief of two-stage booster, 5 bands signal generator. John Arnold, P. O. B. 84, Bluffs, Ill.

SELL OR SWAP—NRI 88 sig. gen., like new. Would like Oak Ridge dynamic 107 tube tester or what have you? Charles Heinicke, 509 Academy Rd., Baltimore 28, Md.

SELL OR SWAP—Standard Cascode tuner, with tubes, perfect condition. Intercarrier, $22.50 cash or $27.50 worth of new tubes of my choice at 50% off list, plus postage. C. Elgasser Jr., 1920 Fern St., San Diego 2, Calif.

WANTED—Wide angle and telepho lenses for Leica camera. Will buy or trade. Have National NC100X and four years of ELECTRONICS magazines to date. Hudson Marhoff, 604-15th St., Kenosha, Wis.

WANTED — Simpson wavemeter, madel 380, complete perf. cond. or good made grid-dip meter. Range up to 420 mc. Jos. Zukauskas, 2227 Germantown Ave., Phila. 33, Pa.

FOR SALE OR SWAP—Radios needing slight repairs. 22x Telescope, Radio City VOM. Would like 7" TV receiver or what have you? Karl Nester, Box 76, Van Meter, Pa.

SWAP—Standard brand 6 BG6's, 19 BG6's, etc., for good useable test equip. and comm. rec., or What have you? No dealers. S. Consalvo, 2507 Southern Ave., SE. Wash 20, D. C.

FOR SALE — Heathkit-TS-2 sweep gen. Factory cal. $22; G. E. tube checker TC-3p, $15; Supreme 3" osc. 546-A, $23; Paint-sprayer "Speedy" (Sears & Roe). Comp. with motor, $18. E. McGee, 41 Birch St., Worcester 3, Mass.

FOR SALE — Meissner ex signal shifter with FMX modulator and power supply $50. 40 watt AM modulator with power and supply and built in speech clipping $25. Mobile xmitter 10 and 75 M 2E26 final $15. A. H. Davis, 34 W. Girard Blvd., Kenmore 17, N. Y.

FOR SALE—Complete AN-PRS-1 mine detector in original case with spare parts, $35 F. O. B. Also command transmitter for novice rig—BC457A, 4-5.3 mc. now tuned to 80 meter band with tubes, $15 prepaid. B. G. Whitehill, 54 Poplar Ave., Niles, Ohio.

SWAP—12" spark tesla coil—Medical diathermy (makes fine transmitter). 300 tubes—Want RCA 154 B. F. O. hand tools, VTVM (Elco or Service Ins. Co.); good auto radio for 1950 Chrysler. R. Denmark, 1475 Walton Ave., Bronx 52, N. Y.

FOR SALE—IRC, L. C. 1 loudness control. Perfect, shaft cut off 1/2" from original length. F. O. B. $3. Hal Magargle, 4812 Cooper La., Hyattsville, Md.

FOR SALE — Complete amateur station now in use 50 watt. Phone—CW XMTR, 10-20-40-80 MTRS; RCA VFO Eddystone Rcvr 1.8-31 mc., $110 FOB. R. T. Kelland, c-o Radio station WFBR, Baltimore 2, Md.

FOR SALE OR SWAP—NR1 model 1175-B sig. gen. Set tester Comb., comp. with new batteries and instructions. Want a—35mm slide proj. or what have you J. Sincoff, 644 W. 173rd St., N. Y. 32, N. Y.

SWAP OR SELL—Stromberg Carlson. 30 watt 3 channel amplifier, model 20, 30 to 10,000 C. P. S. hi fidelity, Jensen coaxial speaker like new, Rider's TV man. 2 and 4. Radio City Prods. mod. 446 multiteser. Want tape or wire rec., also late model BC221. Local preferred. S. A. Hirsh, 386 Berriman St., Brooklyn 8, N. Y.

WANTED—Power pack to fit in BC-312 surplus rec. Dual vol. cont. For same 16mm silent proj. and all type silent films. Will trade bound CREI course, Ham parts, service equip. Bob Eubank, Box 846, Medical College, Richmond 19, Va.

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